What is claimed is:

1. A micro-mechanical hinge comprising:

a lower bracket;

an upper bracket;

a middle section with an opening in a plane;

a pin that is normal to the plane and sized to closely fit within the opening;

the upper and lower brackets being fixedly coupled to corresponding opposite ends of the pin on opposite sides of the middle section and having dimensions within the plane that are greater than the size of the opening so that movement of the middle section relative to the first component, the second component, and the pin is limited to rotation in the plane and bracketed by the lower and upper brackets.

2. The micro-mechanical hinge of claim 1 further comprising:

an anchor that fixedly couples the first component to the corresponding opposite end of the pin; and

a via that fixedly couples the second component to the corresponding opposite end of the pin.

3. The micro-mechanical hinge of claim 1 wherein:

the first, second, and third components are respectively formed from first, second, and third major layers of polysilicon;

the anchor is formed from a first intermediate layer of polysilicon between the first and second major layers of polysilicon; and

the via is formed from a second intermediate layer of polysilicon between the second and third major layers of polysilicon.

4. The micro-mechanical hinge of claim 1 wherein the opening and the pin are round, the size comprises a diameter, and the dimensions comprise cross sections

5. A micro-mechanical hinge comprising:

a base ring;

a rotation ring disposed within the base ring;

a hinge pin disposed within the rotation ring;

one or more attachment arms that fixedly couple the hinge pin to the base ring and guide the rotation ring as it rotates about the hinge pin's axis and within the base ring; and

a support arm having (a) a first end fixedly coupled to the rotation ring, and (b) a second end that rotates about the hinge pin's axis when the rotation ring rotates.

6. The micro-mechanical hinge of claim 5 further comprising:

first vias that fixedly couple the one or more attachment arms to the hinge pin and the base ring; and

second vias that fixedly couple the first end of the support arm to the rotation ring.

7. The micro-mechanical hinge of claim 1 wherein:

the base ring, the rotation ring, and the hinge pin are all formed from a first major layer of polysilicon;

the attachment arms and the support arm are all formed from a second major layer of polysilicon; and

the vias are formed from an intermediate layer of polysilicon between the first and second major layers of polysilicon.

8. A micro-mechanical pivot hinge comprising:

a first hinge plate with an opening;

a pivot pin disposed in the opening of the base plate;

a second hinge plate fixedly coupled to the pivot pin; and

at least one extension arm fixedly coupled to the first hinge plate and extending over the opening of the first hinge plate and the pivot pin;

wherein the at least one extension arm and the second hinge plate are configured to act in conjunction to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

9. The micro-mechanical pivot hinge of claim 8 wherein:

the pivot pin comprises at least one attachment arm;

the pivot plate comprises at least one attachment arm that is fixedly coupled to the attachment plate of the pivot pin.

10. The micro-mechanical pivot hinge of claim 9 wherein the at least one attachment arm of the pivot plate has a length and a width that extends along the pivot pin's axis past the opening of the first hinge plate and over the first hinge plate so as to act in conjunction with the first hinge plate and the locking arm to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

11. The micro-mechanical pivot hinge of claim 8 further comprising a via that fixedly couples the second hinge plate to the pivot pin.

12. The micro-mechanical pivot hinge of claim 11 wherein:

the first hinge plate and the hinge pin are formed from a first major layer of polysilicon;

the second hinge plate and the extension arm are formed from a second major layer of polysilicon; and

the via is formed from an intermediate layer of polysilicon between the first and second major layers of polysilicon.

13. A MEMS reconfigurable vee antenna comprising:

a transmission line end comprising conductors;

antenna arms, each of the antenna arms being rotatably coupled to a corresponding one of the conductors;

actuator mechanisms; and

support arms, each of the support arms having one end rotatably coupled to a corresponding one of the antenna arms and the other end rotatably coupled to a corresponding one of the actuator mechanisms;

wherein, for each of the actuator mechanisms, when the actuator mechanism is controlled to move linearly forward, the corresponding support arm pushes on the corresponding antenna arm so as rotate the corresponding antenna arm inward, and when the actuator mechanism is controlled to move linearly backward, the corresponding support arm pulls on the corresponding antenna arm so as rotate the corresponding antenna arm outward.

14. The MEMS reconfigurable vee antenna of claim 13 wherein the transmission line end comprises a CPS transmission line end and the conductors comprise a pair of coplanar conductors.

15. The MEMS reconfigurable vee antenna of claim 13 wherein the transmission line comprises a CPW transmission line end and the conductors comprise a pair of ground plane conductors and a center conductor.

16. The MEMS reconfigurable vee antenna of claim 13 further comprising:

first micro-mechanical hinges, each of the first micro-mechanical hinges rotatably coupling one of the antenna arms to a corresponding one of the conductors;

second micro-mechanical hinges, each of the second micro-mechanical hinges rotatably coupling one end of a corresponding one of the support arms to a corresponding one of the antenna arms; and

third micro-mechanical hinges, each of the third micro-mechanical hinges rotatably coupling one end of a corresponding one of the support arms to a corresponding one of the actuator mechanisms.

17. The MEMS reconfigurable vee antenna of claim 16 wherein each first micro-mechanical hinge comprises:

a first component;

a second component;

a third component with an opening in a plane;

a pin that is normal to the plane and sized to closely fit within the opening;

the first and second components being fixedly coupled to corresponding opposite ends of the pin on opposite sides of the third component and having dimensions within the plane that are greater than the size of the opening so that movement of the third component relative to the first component, the second component, and the pin is limited to rotation in the plane.

18. The MEMS reconfigurable vee antenna of claim 17 wherein each first micro-mechanical hinge further comprises:

an anchor that fixedly couples the first component to the corresponding opposite end of the pin; and

a via that fixedly couples the second component to the corresponding opposite end of the pin.

19. The MEMS reconfigurable vee antenna of claim 18 wherein for each first micro-mechanical hinge:

the first, second, and third components are respectively formed from first, second, and third major layers of polysilicon;

the anchor is formed from a first intermediate layer of polysilicon between the first and second major layers of polysilicon; and

the via is formed from a second intermediate layer of polysilicon between the second and third major layers of polysilicon.

20. The micro-mechanical hinge of claim 17 wherein the opening and the pin are round, the size comprises a diameter, and the dimensions comprise cross sections

21. The MEMS reconfigurable vee antenna of claim 16 wherein each second and third micro-mechanical hinge comprises:

a base ring;

a rotation ring disposed within the base ring;

a hinge pin disposed within the rotation ring;

one or more attachment arms that fixedly couple the hinge pin to the base ring and guide the rotation ring as it rotates about the hinge pin's axis and within the base ring; and

a support arm having (a) a first end fixedly coupled to the rotation ring, and (b) a second end that rotates about the hinge pin's axis when the rotation ring rotates.

22. The MEMS reconfigurable vee antenna of claim 21 wherein each second and third micro-mechanical hinge further comprises:

first vias that fixedly couple the one or more attachment arms to the hinge pin and the base ring; and

second vias that fixedly couple the first end of the support arm to the rotation ring.

23. The MEMS reconfigurable vee antenna of claim 22 wherein for each second and third micro-mechanical hinge:

the base ring, the rotation ring, and the hinge pin are all formed from a first major layer of polysilicon;

the attachment arms and the support arm are all formed from a second major layer of polysilicon; and

the vias are formed from an intermediate layer of polysilicon between the first and second major layers of polysilicon.

24. A MEMS docking switch comprising:

a first conductor;

an opposing second conductor;

a moveable insulating plate;

an electrical contact fixedly coupled to the underside of the moveable insulating plate;

actuator mechanisms; and

support arms, each of the support arms having one end laterally moveably and rotatably coupled to a corresponding one of the actuator mechanisms and the other end vertically moveably and rotatably coupled to the moveable insulating plate;

wherein, when the actuator mechanisms are controlled to move backward, the support arms pull the moveable insulating plate down until the electrical contact is laid down on and contacts the conductors, and when the actuator mechanisms are controlled to move forward,

the support arms push the moveable insulating plate up until the electrical contact is lifted up from and no longer contacts the conductors.

25. The MEMS docking switch of claim 24 further comprising:

first micro-mechanical pivot hinges, each of the first micro-mechanical pivot hinges laterally moveably and rotatably coupled one end of a corresponding support arm to a corresponding one of the actuator mechanisms; and

second micro-mechanical pivot hinges, each of the second micro-mechanical pivot hinges laterally moveably and rotatably coupled one end of a corresponding support arm to the moveable insulating plate.

26. The MEMS docking switch of claim 25 wherein each of the first and second micro-mechanical pivot hinges comprises:

a first hinge plate with an opening;

a pivot pin disposed in the opening of the base plate;

a second hinge plate fixedly coupled to the pivot pin; and

at least one extension arm fixedly coupled to the first hinge plate and extending over the opening of the first hinge plate and the pivot pin;

wherein the at least one extension arm and the second hinge plate are configured to act in conjunction to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

27. The MEMS docking switch of claim 26 wherein for each of the first and second micro-mechanical pivot hinges:

the pivot pin comprises at least one attachment arm;

the pivot plate comprises at least one attachment arm that is fixedly coupled to the attachment plate of the pivot pin.

28. The MEMS docking switch of claim 27 wherein, for each of the first and second micro-mechanical pivot hinges, the at least one attachment arm of the pivot plate has a length and a width that extends along the pivot pin's axis past the opening of the first hinge plate and

over the first hinge plate so as to act in conjunction with the first hinge plate and the locking arm to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

29. The MEMS docking switch of claim 28 wherein each of the first and second micro-mechanical pivot hinges further comprises a via that fixedly couples the second hinge plate to the pivot pin.

30. The MEMS docking switch of claim 29 wherein, for each of the first and second micro-mechanical pivot hinges:

the first hinge plate and the hinge pin are formed from a first major layer of polysilicon;

the second hinge plate and the extension arm are formed from a second major layer of polysilicon; and

the via is formed from an intermediate layer of polysilicon between the first and second major layers of polysilicon.

31. A MEMS derrick switch comprising:

an insulating layer;

a first conductor fixedly coupled to the insulating layer;

an opposing second conductor fixedly coupled to the insulating layer;

a pivot arm having a first end rotatably coupled to the insulating layer so that a second end of the pivot arm pivots about the first end;

an actuator mechanism;

a support arm having a first end rotatably coupled to the second end of the pivot arm and a second end laterally moveably and rotatably coupled to the actuator mechanism;

an insulating attachment arm fixedly coupled to the second end of the pivot arm; and

an electrical contact fixedly coupled to the underside of the insulating attachment arm;

wherein, when the actuator mechanism is controlled to move forward, the support arm pushes the second end of the pivot arm down until the electrical contact is laid down on and contacts the conductors, and when the actuator mechanism is controlled to move backward,

the support arm pulls the second end of the pivot arm up until the electrical contact is lifted up from and no longer contacts the conductors.

32. The MEMS derrick switch of claim 31 further comprising:

a first micro-mechanical pivot hinge that laterally moveably and rotatably couples the second end of the support arm to the actuator mechanism; and

a second micro-mechanical pivot hinge that rotatably couples the second end of the support arm to the first end of the second end of the pivot arm; and

a third micro-mechanical pivot hinge that rotatably couples the first end of the pivot arm to the insulating layer.

33. The MEMS derrick switch of claim 32 wherein each of the first, second, and third micro-mechanical pivot hinges comprises:

a first hinge plate with an opening;

a pivot pin disposed in the opening of the base plate;

a second hinge plate fixedly coupled to the pivot pin; and

at least one extension arm fixedly coupled to the first hinge plate and extending over the opening of the first hinge plate and the pivot pin;

wherein the at least one extension arm and the second hinge plate are configured to act in conjunction to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

34. The MEMS derrick switch of claim 33 wherein for each of the first, second, and third micro-mechanical pivot hinges:

the pivot pin comprises at least one attachment arm;

the pivot plate comprises at least one attachment arm that is fixedly coupled to the attachment plate of the pivot pin.

35. The MEMS derrick switch of claim 34 wherein, for each of the first, second, and third micro-mechanical pivot hinges, the at least one attachment arm of the pivot plate has a length and a width that extends along the pivot pin's axis past the opening of the first hinge plate and

over the first hinge plate so as to act in conjunction with the first hinge plate and the locking arm to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

36. The MEMS derrick switch of claim 35 wherein each of the first, second, and third micro-mechanical pivot hinges further comprises a via that fixedly couples the second hinge plate to the pivot pin.

37. The MEMS derrick switch of claim 36 wherein, for each of the first, second, and third micro-mechanical pivot hinges:

the first hinge plate and the hinge pin are formed from a first major layer of polysilicon;

the second hinge plate and the extension arm are formed from a second major layer of polysilicon; and

the via is formed from an intermediate layer of polysilicon between the first and second major layers of polysilicon.

38. A MEMS see-saw switch comprising:

an insulating layer;

a first conductor fixedly coupled to the insulating layer;

an opposing second conductor fixedly coupled to the insulating layer;

a first electrode fixedly coupled to the insulating layer;

a second electrode fixedly coupled to the insulating layer;

a conductive pivot arm having a first end over the first electrode, a second end over the second electrode, and a center rotatably coupled to the insulating layer so that a first end and a second end of the pivot arm can pivot about a rotation axis at the center of the pivot arm;

an insulating attachment arm fixedly coupled to the second end of the pivot arm; and

an electrical contact fixedly coupled to the underside of the insulating attachment arm;

wherein, when a voltage is applied between the first electrode and the pivot arm, the first end of the pivot arm is pulled down until the electrical contact is laid down on and

contacts the conductors, and when a voltage is applied between the second electrode and the pivot arm, the second end of the pivot arm is pulled down until the electrical contact is lifted up from and no longer contacts the conductors.

39. The MEMS see-saw switch of claim 38 further comprising a hinge that rotatably couples the center of the pivot arm to the insulating layer.

40. The MEMS see-saw switch of claim 38 wherein the hinge comprises a spring hinge comprising:

support bases fixedly coupled to the insulating layer and between which the center of the pivot arm is located; and

spring arms that are fixedly coupled to the support bases and the center of the pivot arm so as to suspend the pivot arm and provide a spring constant for pivoting of the first and second ends of the pivot arm.

41. A MEMS reconfigurable capacitor comprising:

a stationary first plate;

a moveable second plate;

actuator mechanisms; and

support arms, each of the support arms having one end laterally moveably and rotatably coupled to a corresponding one of the actuator mechanisms and the other end vertically moveably and rotatably coupled to the moveable second plate;

wherein, when the actuator mechanisms are controlled to move backward, the support arms pull the moveable second plate down to change the capacitance of the capacitor, and when the actuator mechanisms are controlled to move forward, the support arms push the moveable second plate up to change the capacitance of the capacitor.

42. The MEMS reconfigurable capacitor of claim 41 further comprising:

first micro-mechanical pivot hinges, each of the first micro-mechanical pivot hinges laterally moveably and rotatably coupled one end of a corresponding support arm to a corresponding one of the actuator mechanisms; and

second micro-mechanical pivot hinges, each of the second micro-mechanical pivot hinges laterally moveably and rotatably coupled one end of a corresponding support arm to the moveable second plate.

43. The MEMS reconfigurable capacitor of claim 42 wherein each of the first and second micro-mechanical pivot hinges comprises:

a first hinge plate with an opening;

a pivot pin disposed in the opening of the base plate;

a second hinge plate fixedly coupled to the pivot pin; and

at least one extension arm fixedly coupled to the first hinge plate and extending over the opening of the first hinge plate and the pivot pin;

wherein the at least one extension arm and the second hinge plate are configured to act in conjunction to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

44. The MEMS reconfigurable capacitor of claim 43 wherein for each of the first and second micro-mechanical pivot hinges:

the pivot pin comprises at least one attachment arm;

the pivot plate comprises at least one attachment arm that is fixedly coupled to the attachment plate of the pivot pin.

45. The MEMS reconfigurable capacitor of claim 44 wherein, for each of the first and second micro-mechanical pivot hinges, the at least one attachment arm of the pivot plate has a length and a width that extends along the pivot pin's axis past the opening of the first hinge plate and over the first hinge plate so as to act in conjunction with the first hinge plate and the locking arm to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

46. The MEMS reconfigurable capacitor of claim 45 wherein each of the first and second micro-mechanical pivot hinges further comprises a via that fixedly couples the second hinge plate to the pivot pin.

47. The MEMS reconfigurable capacitor of claim 46 wherein, for each of the first and second micro-mechanical pivot hinges:

the first hinge plate and the hinge pin are formed from a first major layer of polysilicon;

the second hinge plate and the extension arm are formed from a second major layer of polysilicon; and

the via is formed from an intermediate layer of polysilicon between the first and second major layers of polysilicon.

48. A MEMS reconfigurable microstrip transmission line element comprising:

a stationary planar conductor;

a moveable planar conductor;

first actuator mechanisms;

second actuator assembies;

first support arms, each of the first support arms having one end laterally moveably and rotatably coupled to a corresponding one of the first actuator mechanisms and the other end vertically moveably and rotatably coupled to a first end of the moveable planar conductor;

second support arms, each of the second support arms having one end laterally moveably and rotatably coupled to a corresponding one of the second actuator mechanisms and the other end vertically moveably and rotatably coupled to a second end of the moveable planar conductor;

wherein, when the first actuator mechanisms are controlled to move backward or forward, the first support arms pull or push the first end of the moveable planar conductor down or up to change the impedance of the microstrip transmission line element at the first end, and when the second actuator mechanisms are controlled to move backward or forward, the second support arms pull or push the second end of the moveable planar conductor down or up to change the impedance of the microstrip transmission line element at the second end.

49. The MEMS reconfigurable transmission line element of claim 48 further comprising:

first micro-mechanical pivot hinges, each of the first micro-mechanical pivot hinges laterally moveably and rotatably coupled one end of a corresponding support arm to a corresponding one of the actuator mechanisms; and

second micro-mechanical pivot hinges, each of the second micro-mechanical pivot hinges laterally moveably and rotatably coupled one end of a corresponding support arm to a corresponding end of the moveable planar conductor.

50. The MEMS reconfigurable transmission line element of claim 49 wherein each of the first and second micro-mechanical pivot hinges comprises:

a first hinge plate with an opening;

a pivot pin disposed in the opening of the base plate;

a second hinge plate fixedly coupled to the pivot pin; and

at least one extension arm fixedly coupled to the first hinge plate and extending over the opening of the first hinge plate and the pivot pin;

wherein the at least one extension arm and the second hinge plate are configured to act in conjunction to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

51. The MEMS reconfigurable transmission line element of claim 50 wherein for each of the first and second micro-mechanical pivot hinges:

the pivot pin comprises at least one attachment arm;

the pivot plate comprises at least one attachment arm that is fixedly coupled to the attachment plate of the pivot pin.

52. The MEMS reconfigurable transmission line element of claim 51 wherein, for each of the first and second micro-mechanical pivot hinges, the at least one attachment arm of the pivot plate has a length and a width that extends along the pivot pin's axis past the opening of the first hinge plate and over the first hinge plate so as to act in conjunction with the first hinge plate and the locking arm to lock the pivot pin in the opening so that one of the first and the second hinge plates pivots about the pivot pin's axis.

55. The MEMS reconfigurable transmission line element of claim 54 wherein each of the first and second micro-mechanical pivot hinges further comprises a via that fixedly couples the second hinge plate to the pivot pin.

56. The MEMS reconfigurable transmission line element of claim 55 wherein, for each of the first and second micro-mechanical pivot hinges:

the first hinge plate and the hinge pin are formed from a first major layer of polysilicon;

the second hinge plate and the extension arm are formed from a second major layer of polysilicon; and

the via is formed from an intermediate layer of polysilicon between the first and second major layers of polysilicon.

57. A MEMS reconfigurable transmission line element comprising:

moveable coplanar conductors;

first actuator mechanisms;

second actuator mechanisms;

insulating attachment arms, each of the insulating attachment arms having one end fixedly coupled to a corresponding one of the actuator mechanisms and the other end fixedly coupled to a corresponding one of the moveable planar conductors;

wherein, when the actuator mechanisms are controlled to move backward or forward, the insulating attachment arms pull or push the moveable planar conductors out or in to change the impedance of the transmission line element.

58. The MEMS reconfigurable transmission line element of claim 57 wherein the transmission line element does not comprise a stationary center conductor so that the transmission line element comprises a CPS transmission line element.

59. The MEMS reconfigurable transmission line element of claim 57 further comprising a stationary center conductor so that the transmission line element comprises a CPW transmission line element.

60. A MEMS impedance tuner for changing the impedance of a transmission line, the impedance tuner comprising:

a transmission line branch for shunt connection to the transmission line;

a moveable conductive plate suspended over the transmission line branch;

actuator mechanisms;

insulating attachment arms, each of the insulating attachment arms having one end fixedly coupled to a corresponding one of the actuator mechanisms and the other end fixedly coupled to a corresponding side of the moveable conductive plate so as to suspend the moveable conductive plate over the transmission line branch;

wherein, when the actuator mechanisms are controlled to move backward or forward, the moveable conductive plate is moved backward or forward over the transmission line branch to change the impedance of the transmission line.

61. The MEMS reconfigurable transmission line element of claim 60 wherein the transmission line branch comprises a CPS transmission line branch.

62. The MEMS reconfigurable transmission line branch of claim 60 wherein the transmission line branch comprises a CPW transmission line branch.